EWUP TECHNICAL REPORT No. 28

AN ECONOMIC EVALUATION OF WHEAT TRIALS AT ABYUHA AREA, EL-MINYA

(1979/80 and 1980/81 WINTER SEASON)

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By

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NOVEMBER 1982

EGYPT WATER USE AND MANAGEMENT PROJECT

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ABSTRACT

Increased water use efficiency can be accomplished through improved farming practices which make the crops more responsive to water. Zinc deficiencies were identified by EWUP agronomists as a possible constraint to increasing crop production. This report describes the results of two field trials of zinc application on wheat conducted during the 1979/80 and 1980/81 winter seasons respectively. The results show that when zinc was applied, both grain and straw yields were affected. These field trials indicate that wheat does respond to zinc application and that the added returns easily off-set the added costs of application. Based on these two field trials, the increase in returns to water is greatest when zinc is applied at tillering.

15 pages , 3 Tables

مستخلـــــــــص

مصمم

يمكن تحقيق زيادة فى كفاءة استخدام مياه الرى عن طريق استخدام اساليب زراعية منظورة تمكن المحاصيل من استفادة اكبر من المياه . وقد وجد الأخصائيون الزراعيون التابعون لمشروع تطوير الرى أن النقص فـــى الزنك يمكن أن يكون احد العوائق فى سبيل زيادة الانتـــاج .

ويعرض هذا التقرير النتائج التى تم الحصول عليها بعد استخـــدام الزنك فى اثنين من التجارب التى أجريت على القمح فى الموسمين الشتويين ١٩٧٩/٨٠ و ١٩٨٠/٨١ على التوالى . وقد أوضحت النتائج أنه باستخـــدام الزنك حدثت زيادة فى انتاجية الحبوب والتبن ايضا . لذلك تؤكد هذه التجارب الحقلية أن محصول القمح يستجيب للزنك وأن العائد المضاف يعوض التكاليف المضافة المستخدمة . وعلى اساس هاتين التجربتين تكون الزيادة فى العائد الى المياه اكثر ما يمكن عندما يستخدم الزنك فى مرحلة التفريع .

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I. INTRODUCTION

Wheat is the main winter cereal crop in Egypt. It is a staple crop for farm households and also contributes importantly to cash income of farmers. As such, it uses more water and land than any other crop except berseem[1].

Increased water use efficiency can be accomplished by (a) improvements in the water delivery and distribution systems or by (b) improved farming practices which make the crops more responsive to water inputs. Often other inputs are interdependent with water; the interactions between inputs makes it necessary to accomplish water management improvements in a total soil-water-crop system.

One improved farming practice discovered relatively recently is the use of micronutrients to improve the productivity of Egyptian soils. As is consistent with current knowledge about calcareous and sodic soils, deficiencies in micronutrients affect the amount of response of crops to nitrogen and phosphorus applications. For example, Serry[2] found that application of zinc sulfate to calcareous soils resulted in markedly increased yields and only modest responses were observed on loamy clay soils. Abdel Razek[3] later observed the application of

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[1]Farouk Abdel Al and Melvin D. Skold, "Farm Record Planning and Analysis for Study Cases at Abyuha, Mansuriya, and Abu Raya Sites, 1979-80. Egypt Water Use and Management Project. Technical Report No. 23, 1982.

[2]Serry, A., A. Mawardi, S. Awad, and I. A. Aziz, "Effect of Zinc and Manganese on Wheat Production", FAO/SIDA Seminar for Plant Scientists from Africa and Middle East. FAO, Rome, 1974, p. 404-409.

[3]Abdel Razek, A. "A Study of the Effect of Trace Elements on Wheat Grown on Calcareous Soil." Unpublished Ph. D. Dissertation, Cairo University, 1978.

zinc to increase plant height and dry weight in addition to grain yields.

Zinc deficiencies were identified by EWUP Project agronomists as a possible constraint to increasing crop production (Keleg, 1979)[4]. While the potential for zinc application to Egyptian soils has been known, previous research has not illustrated the benefits on farmers' fields. Further, previous research has not included economic analysis of the results.

II. PROCEDURE

This report describes the results of two field trials which were conducted on a farmer's land. The first was conducted during 1979-80 and the second during the 1980-81 winter season.

Giza 157 wheat was subjected to alternative levels of application of zinc sulfate under farmer-field conditions. The 1979-80 trial included a control treatment and three different treatments for zinc sulfate ($ZnSO_4$) application. The variables considerd on the four treatments were:

1) Control -- 0.20 *feddans* which received no $ZnSO_4$.
2) The second treatment included 0.98 *feddan* on which one application of $ZnSO_4$ was applied at the rate of 1.6 kg per *feddan* 44 days after planting (tillering).
3) One treatment of $ZnSO_4$ was applied to a 0.2 *feddan* area 72 days after planting (shooting stage). Zinc sulfate was applied at the rate of 1.6 kg per *feddan*.

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[4]Keleg, A. M., A. D. Dotzenko, M. Zanati and A. A. Abdel Wahed, "Preliminary Soil" Survey Report for the Beni Magdul and El-Hammami Areas". Egypt Water Use & Management Project. Technical Report No. 2, 1979.

4) The final treatment was also applied to 0.98 *feddan* and included two applications of $ZnSO_4$, the first at tillering, and the second at the shooting stage.

The 1980-81 trial included five treatments of different application rates, time and frequency of zinc sulfate ($ZnSO_4$). Zinc treatments were as foliar applications in different concentrations and at different stages of plant growth up through the tillering stage of wheat plants. A control treatment was included plus four treatments. The treatments were:

1) Control -- no $ZnSO_4$ was added.
2) One spraying of 0.4 percent $ZnSO_4$ was applied at a rate of 400 liters per *feddan* 42 days after the planting date.
3) Two foliar sprays of 0.4 percent Zn SO_4 were applied at the same rate; the first spraying was at tillering and the second 10 days following the first. A total of 800 liters per *feddan* were applied.
4) One spraying of 0.6 percent $ZnSO_4$ was applied at the rate of 400 liters per *feddan*. The $ZnSO_4$ was applied at tillering
5) One spraying of 0.8 percent $ZnSO_4$ was applied at tillering at the rate of 400 liters per *feddan*.

In the 1979-80 trial, water application was measured; it differed slightly between the control and the treated area. The table below indicates the measured amounts of water applied in each of six irrigations. Levels of all other inputs remained the same on the control and zinc-treated fields. The first irrigation was applied to the treated area before measurements could be made; consequently the assumption is made that the same volume of water was applied to the treated area as was applied to the control area. The amount of

water applied per *feddan* differs from the amount of water applied shown in the wheat enterprise budgets which is based on the average of all wheat fields on which water was measured at the Minya site.

Table 1. Amount of Water Applied Per *Feddan* During the 1979-80 Zinc Treatment Field Trials at Abyuha

No. of Irrigation	Treatment	
	Control Area	Treated Area
	(m^3 of water applied per *feddan*)	
First irrigation	432	432
Second irrigation	303	405
Third irrigation	375	405
Fourth irrigation	234	358
Fifth irrigation	355	408
Sixth irrigation	347	352
Total, all irrigations	2046	2280

Water management was identical for all treatments in the 1980-81 trial, as were the levels of all other inputs used. Consequently, the only difference between treatments are the changes in yields of wheat and the costs of the $ZnSO_4$ and its application to the wheat. Because of the importance and value of wheat straw, it is necessary to consider the effects of the treatments on straw as well as grain yield.

VII. RESULTS

The results are presented in a partial budgeting format. Since reduced costs and reduced returns (relative to the control) are not encountered, these elements are deleted from the partial budget. An

enterprise budget for wheat serves as the base; it reflects the costs and returns for the control treatment.

The added returns and added costs for the other four treatments are departures from this base case. Enterprise budgets for the two years of wheat at Abyuha are presented as an Appendix. The changes in costs, returns, and returns to water form each treatment are presented in the following tables.

All costs except water are counted in the enterprise budgets. The residual "return above all costs" is the return to management, risk and inputs not valued in the budget. Since management and risk do not vary between treatments, the return above the costs can be indexed to the amount of water applied and changes in water use efficiency between the zinc trials can be inferred.

When the $ZnSO_4$ is applied, both grain and straw yields are affected. On the cost side, the cost of zinc and its application change as do the costs of winnowing and transporting different amounts of grain and straw. The changes which occur in each of the four zinc treatments are summarized in the following tables:

Table 2. Changes in 1979-80 Per *Feddan* Costs and Returns and Value of Output per 1,000 m^3 of Water and Crop Yields, By Treatment

Item	1.6 kg $ZnSO_4$ At Tillering	1.6 kg $ZnSO_4$ At Shooting	3.2 kg $ZnSO_4$, 1.6 kg At Tillering and 1.6 kg At Shooting
Added Returns (L.E.)			
-Grain	57.72	10.01	60.73
-Straw	27.60	69.96	76.44
Added Returns	85.32	59.95	137.17
Increased Costs (L.E.)			
-Zinc Sulfate	0.96	0.96	0.92
-Zinc Application	2.00	2.00	4.00
-Winnowing (½ Kela/Ardeb)	2.75	1.10	3.80
-Transporting (0.75/ardeb)	5.62	1.72	5.80
Increased Costs	12.33	5.78	15.52
Changes in Income/*feddan*	79.99	54.17	121.65
Income/1000 m^3 water	69.34	61.08	53.36
Yield*:			
-Grain (kg/ *feddan*)	2,316	1,534.5	2,350.5
-Straw (kg/ *feddan*	3,575	3,457.5	3,592.5

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* Assuming 150 kg of grain/ardeb and 250 kg of straw/camel load.

Table 3. Changes in 1980-81 Per *Feddan* Costs and Returns and Value of Output per 1,000 m^3 of Water and Crop Yields, By Treatment

Item	1.6 kg $ZnSO_4$ One Spraying	3.2 kg $ZnSO_4$ Two Sprayings	2.4 kg $ZnSO_4$ One Spraying	3.2 kg $ZnSO_4$ One Spraying
Added Returns (L.E.)				
-Grain	98.74	124.62	121.89	81.76
-Straw	41.18	141.89	35.22	40.61
Added Returns	139.92	166.51	157.11	122.37
Increased Costs (L.E.)				
-Zinc Sulfate	1.60	3.20	2.40	3.20
-Zinc Application	5.00	10.00	5.00	5.00
-Winnowing	2.00	3.50	2.50	1.00
-Transporting	1.80	2.40	2.20	1.50
Increased Costs	10.40	19.10	12.10	10.70
Changes in Income/*feddan*	129.52	147.41	145.01	111.67
Income/1000 m^3 water	52.91	60.22	59.23	45.62
Yield:				
-Grain (kg/ *feddan*)	2,416.5	2,700	2,670	2,230.5
-Straw (kg/ *feddan*)	2,650	2,662.5	2,545	2,640

The change in income per *feddan* and change in income per 1000 m^3 of water show the results of the economic analysis. The wheat enterprise budgets reflect the income per *feddan*. Income per *feddan* in 1979-80 is L.E. 85.10 under the control conditions; this is L.E.41.59 per 1000 m^3 of water in 1980-81.

In 1979-80, adding 1.6 kg of $ZnSO_4$ at tillering added L.E. 79.99 income per *feddan* of wheat, income per 1000 m^3 of water was L.E. 69.34. Income per 1000 m^3 of water was only L.E. 35.37 in the control treatment represented by the enterprise budget in the appendix. Applying only 1.6 kg of $ZnSO_4$ per *feddan* at shooting was less profitable than application at tillering, but the distribution of product between grain and straw changed markedly. Applying 1.6 kg of $ZnSO_4$ at both tillering and shooting had the greatest impact on income per *feddan* and income per 1,000 m^3 of water.

In 1980-81, adding 1.6 kg of $ZnSO_4$ increased returns per *feddan* by L.E. 129.52 and gave L.E. 52.91 per 1000 m^3 of water -- a 48 percent increase. The most profitable treatment was to provide two sprayings of $ZnSO_4$ of 1.6 kg/*feddan* each, spacing the sprayings 10 days apart. This treatment was followed closely by applying 2.4 kg of $ZnSO_4$ in one spraying. The results of these field trials indicate that wheat does respond to $ZnSO_4$ applications and that the added returns easily offset the added costs of application. Timing of the foliar applications is also important. Based on these two field trials, it appears that application of at least 1.6 kg per *feddan* at tillering would add most to profits and returns to irrigation water. If as much as 3.2 kg of $ZnSO_4$ are applied, two applications are preferred to a single application.

APPENDIX

1979-1980

CROP ENTERPRISE COST STUDY *

WHEAT at ABUEHA (1), MENYA GUT.

Prepared by: Elia Sorial
Identifier Code: TP-1,Trk-0,F27
Date Prepared: June,1981

EGYPT WATER USE & MANAGEMENT PROJECT

Item	Unit	Number of Units	Price or Value per unit L.E.	Total income or Costs L.E.
Income				
wheat grain	ardab	11.0	13.000	143.00
wheat straw	load	8.0	12.000	96.00
Total Income				239.00
Variable Costs				
plowing & harrowing by tractor	feddan	1.0	8.000	8.00
basins by axes	man hour	30.0	0.150	4.50
super phosphate (o-15-o)	kg.	100.0	0.030	3.00
labor to spread super phos.	man hour	2.0	0.150	0.30
seeds	kela	6.0	1.250	7.50
labor to spread seeds	man hour	2.0	0.150	0.30
weeding	boy hour	50.0	0.080	4.00
ammonium nitrate (31-0-0)	kg.	200.0	0.063	12.60
labor to spread chemical fert.	man hour	2.0	0.150	0.30
Irrigation by gravity (2)		0.0	0.000	0.00
labor to spread water	man hour	36.0	0.150	5.40
Harvesting		0.0	0.000	0.00
labor for harvesting	man hour	100.0	0.250	25.00
threshing by machine	machine hour	6.0	1.500	9.00
labor for thresing	man hour	36.0	0.250	9.00
labor for winnowin (3)	man hour	20.0	0.300	6.00
trasport the grain	ardab	10.0	0.300	3.00
Total Variable Costs				97.90
Return Above Variable Costs				141.10
Fixed Costs				
Land rent	month	7.0	6.500	45.50
management charge	month	7.0	1.500	10.50
Total Fixed Costs				56.00
Grand Total Costs				153.90
Return Above All Costs				85.10

FOOTNOTES:

* This study for an area of one feddan.
(1) planing time is Nov. 20 to Dec. 20 .Harveting time is May 1 to 25
previos crops cotton or soya-bean
(2) first irrigation after planting 6 hours
second irrigation after 25 days 5 hours
third " winter closure 5 hours
then 1irrigation each 15 - 20 days (4x5 hours) 20 hours
TOTAL irrigation hours 36 hours
(3) costs of winnowing half kela grain for each ardab from the production . we transfered these costs to man hour

	LABOR DISTRIBUTION			WATER DISTRIBUTION, CU METERS			
	Man Hours	Woman Hours	Boy/Girl Hours	First Irrig.	Second Irrig.	Third Irrig.	Fourth Irrig.
October	0	0	0	0	0	0	0
November	32	0	0	0	0	0	0
December	14	50	0	476	222	0	0
January	0	0	0	0	0	0	0
February	11	0	0	512	232	0	0
March	10	0	0	253	406	0	0
April	0	0	0	305	0	0	0
May	136	0	0	0	0	0	0
June	20	0	0	0	0	0	0
July	0	0	0	0	0	0	0
August	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0
Total	223	50	0	Total Water Applied=		2406 cu meters	

FOOTNOTES:

(1) Water requirement measured by EWUP.

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CROP ENTERPRISE COST STUDY *

Wheat at Abuseha, El Menya Governorate, Winter 1980-1981 (1)

EGYPT WATER USE & MANAGEMENT PROJECT

Prepared by: Nabil Kamal Faraq — ECONOMICS DISCIPLINE
File Name: DMINI
Date Prepared: March 1982

Item	Unit	Number of Units	Value Per Unit L.E.	Income or Cost L.E.
Income				
Wheat	Ardab	8.9	13.700	121.9
Wheat Straw (2)	Camel Load	7.7	14.200	109.3
Total Income				231.3
Variable Costs				
Land Preparation				
Plowing	Tractor Hour	4.3	1.400	6.0
Prepare Borders	Man Hour	41.2	0.180	7.4
Planting				
Seed	Kela	4.2	1.530	6.4
Labor for Planting	Man Hour	1.2	0.200	0.2
Chemical Fertilizer (3)				
Ammium Nitrate (33.5-0-0)	Kilogram	182.0	0.066	12.0
Labor to Spread Fertilizer	Man Hour	2.3	0.200	0.5
Irrigation (4)				
Labor to Spread Water	Man Hour	30.4	0.250	7.6
Harvesting				
Labor for Harvesting	Man Hour	82.1	0.200	12.4
Threshing	Machine Hour	5.3	1.800	9.5
Labor for Threshing	Man Hour	14.5	0.450	6.5
Winnowing	Man Hour	11.5	0.560	6.4
Transportation	Donkey Hour	14.9	0.050	0.7
Labor to Load & Drive An.	Man Hour	14.9	0.190	2.8
Total Variable Costs				83.7
Return Above Variable Costs				147.6
Fixed Costs				
Land Rent (5)	Month	7.0	7.600	53.2
Management Charge	Month	7.0	1.000	7.0
Total Fixed Costs				60.2
Grand Total Costs				143.9
Return Above All Costs				87.4

FOOTNOTES:

* This study for an area of one feddan.
EWUP Farm Record Data for Abuseha, 1980-1981.
(1) Planted December 1 - 15, 1980; Harvested May 15 - 30, 1981.
(2) A camel load of straw weighs approximately 250 kilograms.
(3) The fertilizer price is the average price for fertilizer purchased from the coop and the free market.
(4) Irrigation by gravity.
(5) The rental rate for land is computed as seven times the taxes (legal rental rate).

	LABOR DISTRIBUTION			WATER DISTRIBUTION, CU METERS			
	Man Hours	Woman Hours	Boy/Girl Hours	First Irrig.	Second Irrig.	Third Irrig.	Fourth Irrig.
November	41	0	0	0	0	0	0
December	12	0	0	413	332	0	0
January	0	0	0	0	0	0	0
February	6	0	0	643	0	0	0
March	11	0	0	410	353	0	0
April	6	0	0	297	0	0	0
May	128	0	0	0	0	0	0
June	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0
August	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0
Total	203	0	0	Total Water Applied =		2448 Cu Meters	

Ratio of Return over Variable Costs to Water Applied = 0.0603
Ratio of Return over All Costs to Water Applied = 0.0357

FOOTNOTES:

* Water distribution quantities are based on EWUP engineering measurements.

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AMERICAN EQUIVALENTS OF EGYPTIAN ARABIC TERMS AND MEASURES COMMONLY USED IN IRRIGATION WORK

Land Area	in *sq meters*	in *acres*	in *feddans*	in *hectares*
1 acre	4,046.856	1	0.96335	0.40469
1 *feddan*	4,200.8335	1.03805	1	0.42008
1 hectare(ha)	10,000.00	2.47105	2.38048	1
1 *sq* kilometer	100 x 10^4	247.105	238.048	100.00
1 *sq* mile	259 x 10^6	640.00	616.4	259.00

Water Measures

1 billion m^3 = 810,710 acre-feet
1000 m^3 = 0.81071 acre-foot = 9.72852 acre-inch
1000 m^3/*feddan* = 0.781 acre-foot/acre = 9.372 acre-inch/acre
(= 238 mm of rainfall)

Other Conversions

1 *ardeb* = 198 liters = 5.62 bushels (U.S)
1 *ardeb/feddan* = 5.41 bushels/acre
1 kg/*feddan* = 2.12 lb/acre
1 donkey load = 100 kg
1 camel load = 250 kg
1 donkey load of manure = 0.1 m^3
1 camel load of manure = 0.25 m^3

Egyptian Unit for Field Crops

Crop	Eg. Unit	in kg	in lbs	in bushels
Lentils	*ardeb*	160.0	352.42	5.87
Clover	*ardeb*	157.0	345.81	5.76
Broad beans	*ardeb*	155.0	341.41	6.10
Wheat	*ardeb*	150.0	330.40	5.51
Maize,Sorghum	*ardeb*	140.0	308.37	5.51
Barley	*ardeb*	120.0	264.32	5.51
Cottonseed	*ardeb*	120.0	264.32	8.26
Sesame	*ardeb*	120.0	264.32	
Groundnut	*ardeb*	75.0	165.20	7.51
Rice	*dariba*	945.0	2081.50	46.26
Chick-peas	*ardeb*	150.0	330.40	
Lupine	*ardeb*	150.0	330.40	
Linseed	*ardeb*	122.0	268.72	
Fenugreek	*ardeb*	155.0	341.41	
Cotton(unginned)	*metric qintar*	157.5	346.92	
Cotton(lint or ginned)	*metric qintar*	50.0	110.13	

Egyptian Farming and Irrigation Terms

fara[1] = branch
marwa = small distributer, irrigation ditch
masraf = field drain
mesqa = small canal feeding from 10 to 40 farms
qirat = cf. English "karat," A land measure of 1/24 *feddan*, 175.03 m^2
qaria = village
sahm = 1/24th of a *qirat*, 7.29 m^2
saqia = animal-powered water wheel
sarf = drain (vb.), or drainage. See also *masraf*, (n.)

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